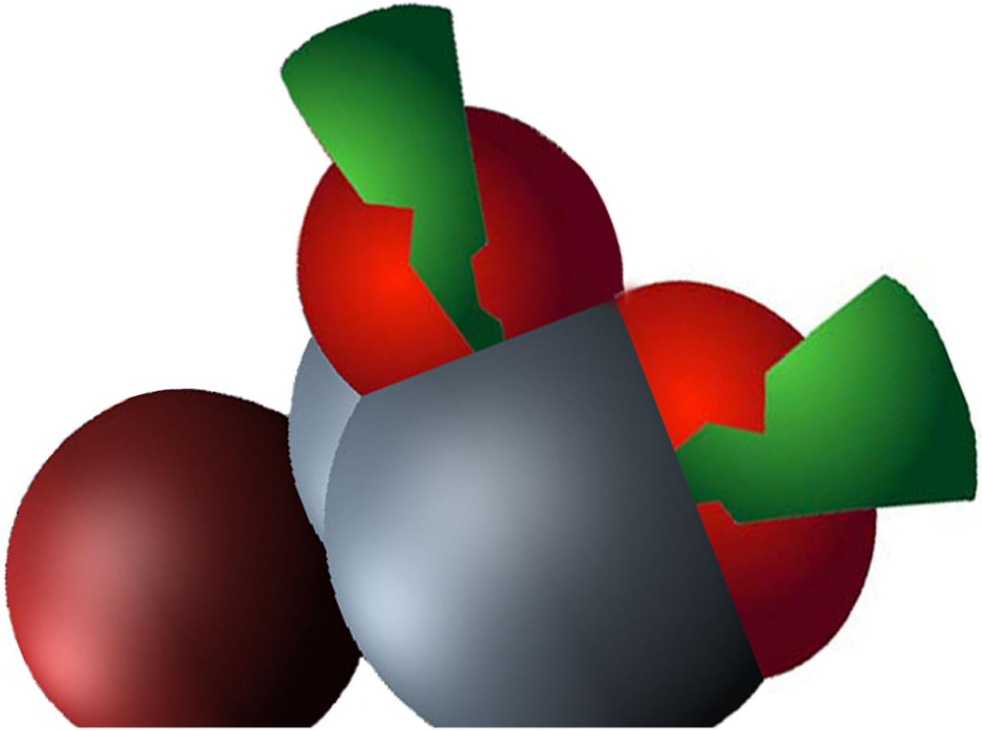


Modified Activated Carbon (MAC) technology

MAC TECHNOLOGY CENTER TEAM

D. Jack Adams

Jan D. Miller

Terrence D. Chatwin

Ximena Diaz

Dale Richards

TEAM QUALIFICATIONS

- This team has worked together successfully
- Developed new technologies
- Developed and managed successful centers
- Developed and managed successful businesses
- Successfully introduced new products & services into the marketplace

TECHNOLOGY STATUS

- One patent issued
- Three provisional patents pending
- One invention disclosure submitted
- One provisional patent underway
- 2nd invention disclosure underway

MODIFIED ACTIVATED CARBON TECHNOLOGY

Molecular and surface modifications that alter activated carbon's sorption properties

- Chemically modified activated carbon
- Biologically modified activated carbon
- Can be combined with magnetic properties

Collectively referred to as Modified Activated Carbon – MAC

MAC BENEFITS

More Effective – More Economical

Technology Advantages

- Faster sorption kinetics
- Higher loading capacity
- **Better contaminant removal**

Economic Advantages

- Lower capital & operating costs
- Low cost magnetic separation
- Longer life – reuse potential

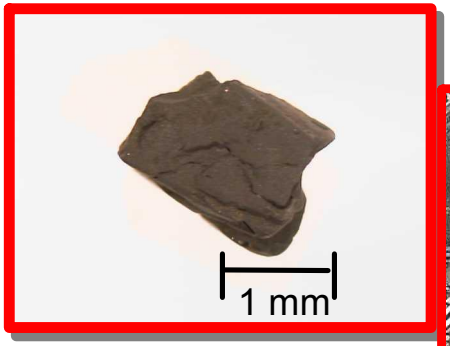
MAC Arsenic Removal - $0.10 - $0.25 / 1,000 gal

Current Technologies
$0.25 - $3.99/1,000 gal
Not completely effective

ARSENIC EXAMPLE

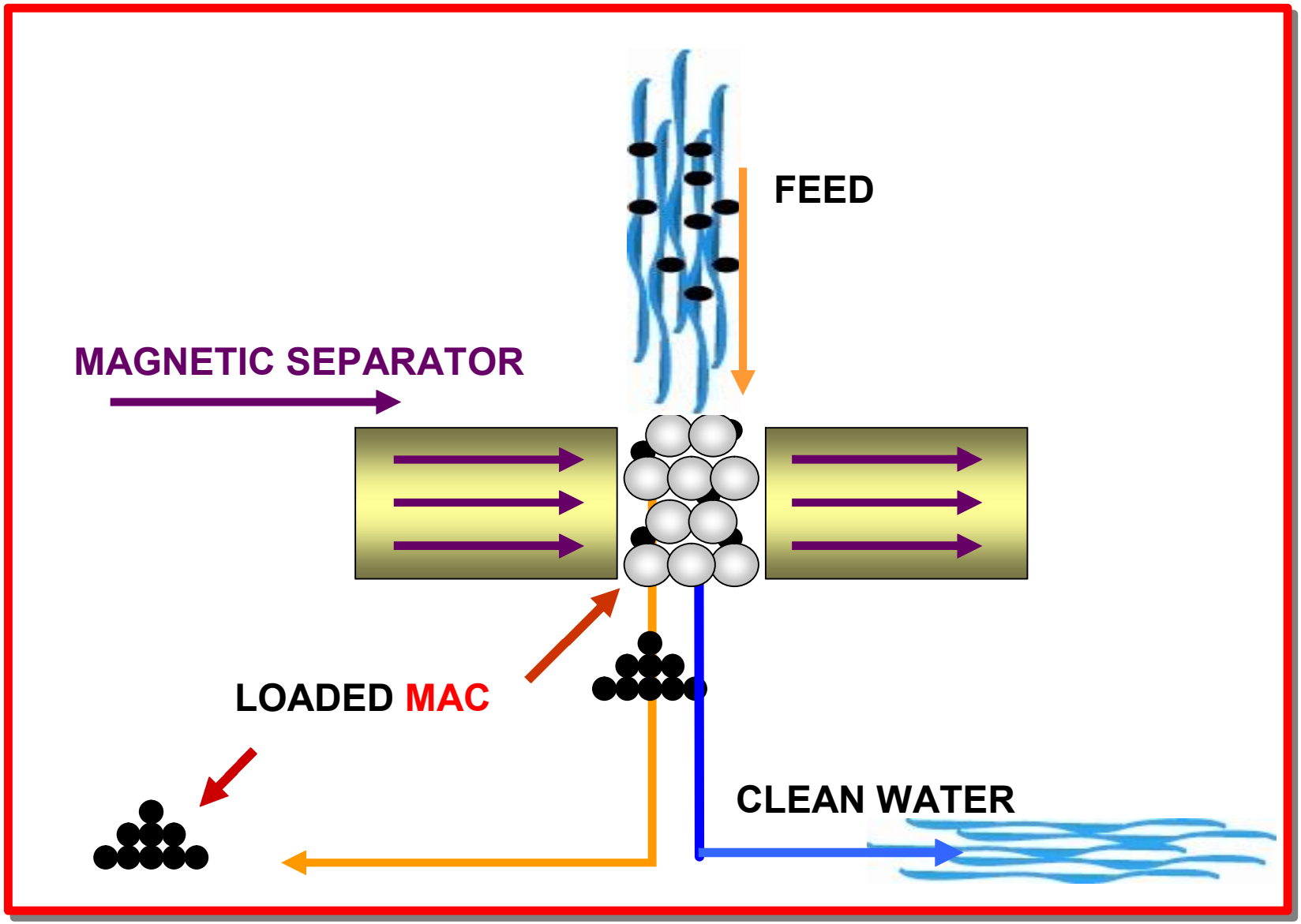
ARSENIC TREATMENTS	*MAC*	Anaerobic /H_2S[5]	Lime [2,3,4]	Chemical Reduction[2,3,4]	Activated Alumina[2,3]	Ion Exchange[2]	Ferric Precipitation[2,3]	Reverse Osmosis
Treatment Time (hr)	Low (1 – 4)	Medium	Low	Medium	Medium	Low	Medium	Medium
pH Range	Broad (3 to 8.5)	Medium	Narrow	Narrow	Narrow	Narrow	Narrow	Med/ Broad
Arsenic Concentration (mg/L)	Low/Med/ High (<1 to >50)	Low/Med/ High	Med/ High	Med/High	Med/ High	High	High	Med/ High
Treatment Cost*	Low ($0.10 to $0.25 / 1,000 gal)	Low	Med/ High	High	High	High	Low	High
Meets Discharge Criteria	Yes	Yes	No	No	No	Not Always	Not Always	Yes

SURFACE AREA

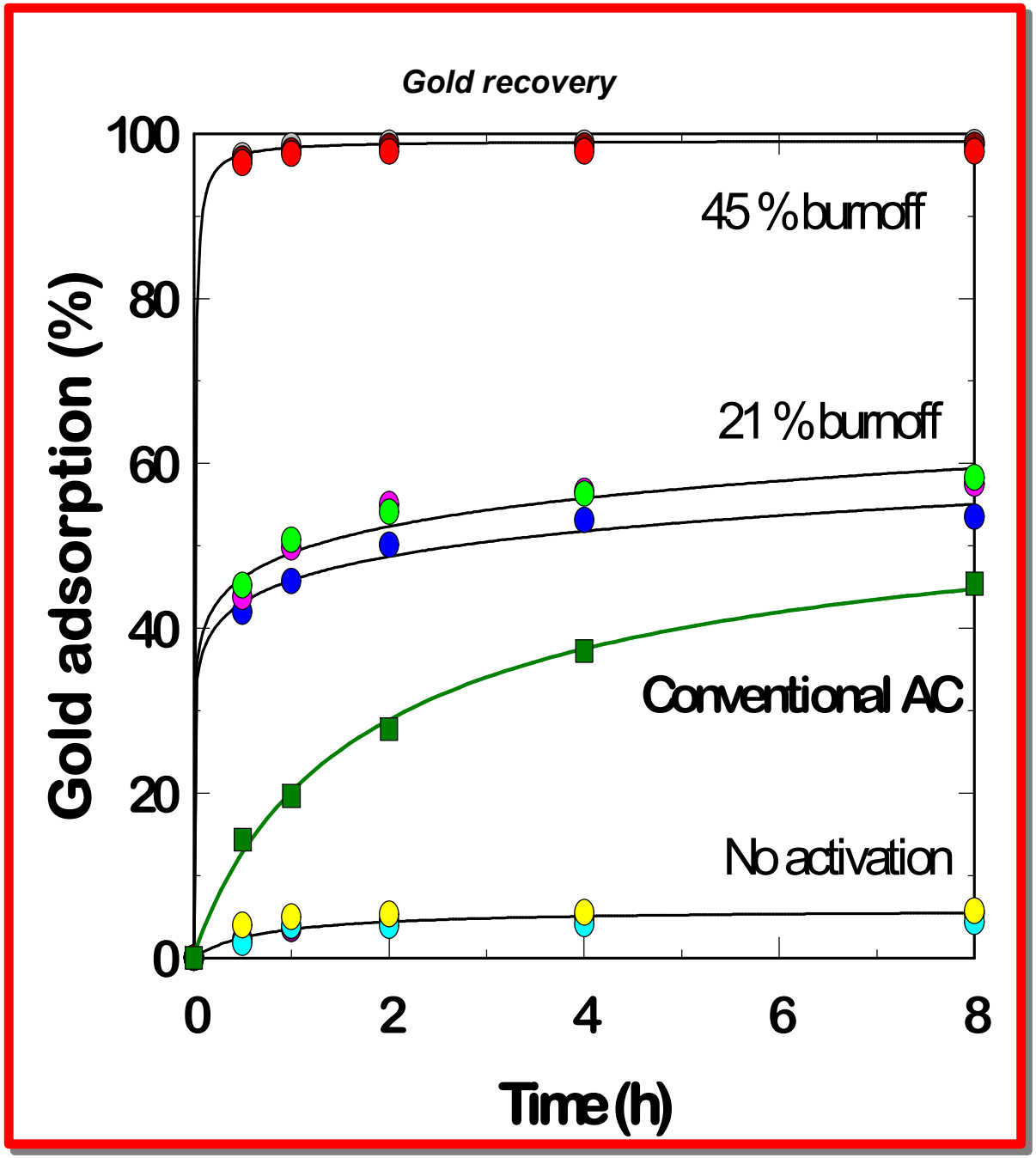


- **MAC can come from any source**
  - Wood chips, sawdust, organic waste, etc.
- **8 grams of activated carbon can have the surface area of a football field**
- **Comes in different forms**
  - Granular activated carbon
  - Powdered activated carbon – including nano particles
  - Pellitized in various macro sizes and durability
  - Can be incorporated into various materials - fabrics

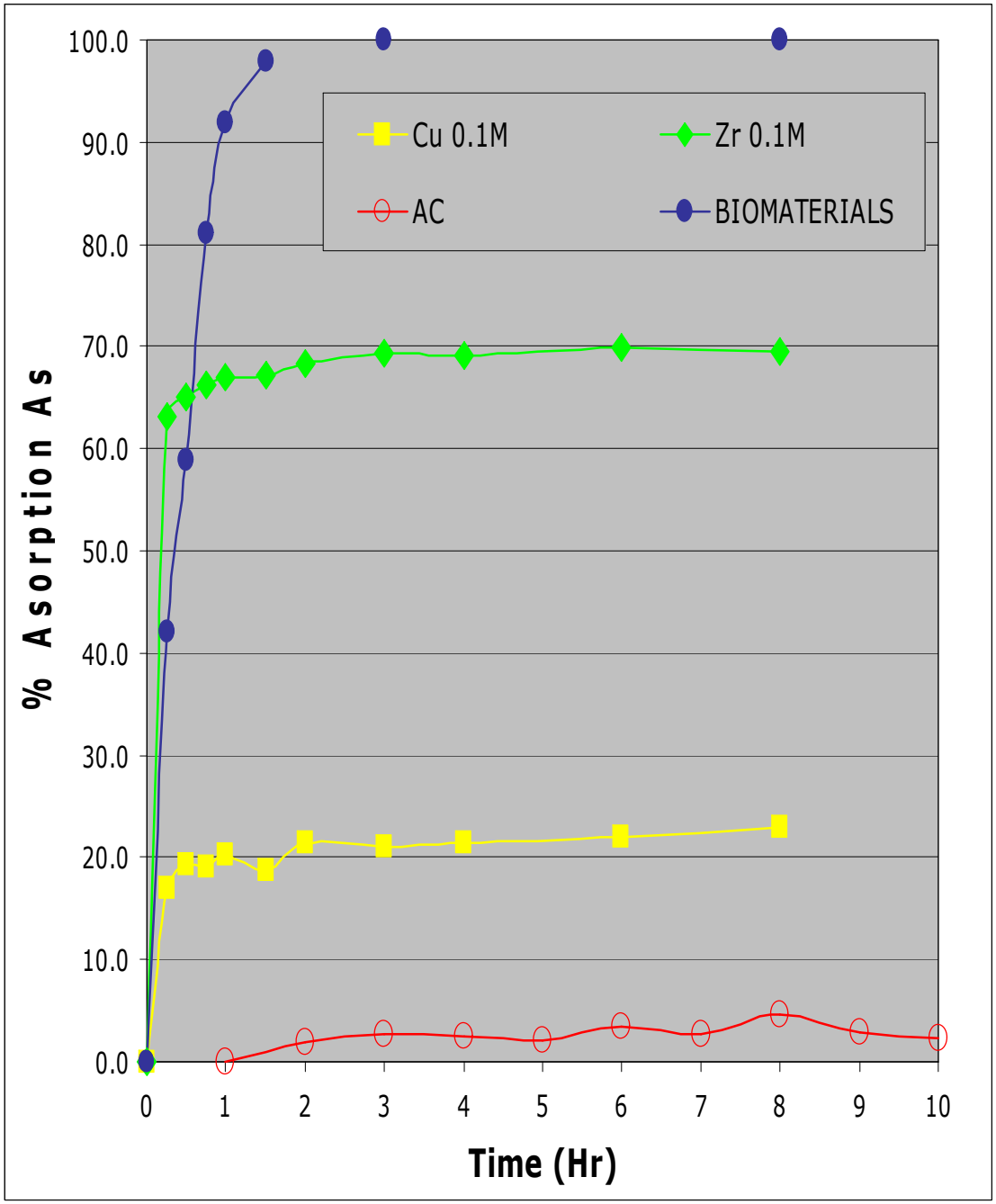
MAGNETIC SEPARATION



MINING INDUSTRY- GOLD SORPTION



Miller, Munoz and Duyvesteyn, 2004



MUNICIPAL WATER TREATMENT-ARSENIC

Adams, Diaz, Mankhand, Miller, Pennington, & Chatwin – 2005

MARKETS

INITIAL FOCUS

MINING

MUNICIPAL WATER TREATMENT (ARSENIC)

FUTURE MARKETS

CHEMICAL PLANTS

COAL FIRED POWER PLANTS

PETROLEUM REFINERIES

AGRICULTURE

MEDICAL

ASSAY MATERIALS

DISINFECTION

MARKET APPLICATION AREAS

INITIAL FOCUS

METAL RECOVERY

WATER TREATMENT

FUTURE FOCUS

NANO PARTICLE APPLICATIONS

GAS TREATMENT

FOOD AND BEVEREGE ANALYSIS

MAC COMMERCIAL BENEFITS

POTENTIAL NEW BUSINESS

- Mac Products / Biomaterials Production

STRATEGIC BUSINESS PARTNERS

- Carbon Manufacturing, Sales, Distribution

NEW JOBS – EXISTING COMPANIES

- Consulting
- Engineering Services
- Analysis

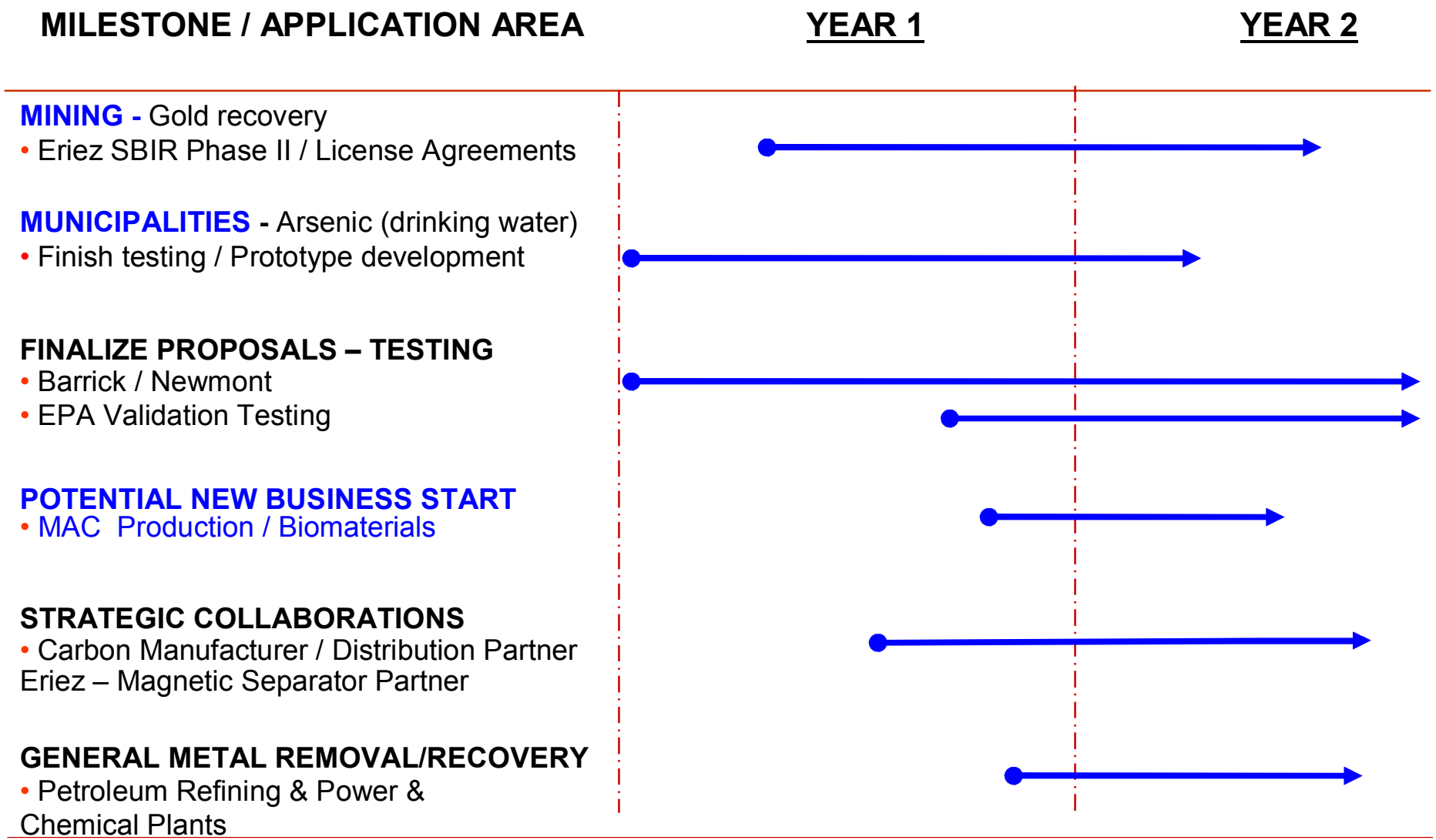
MAGNETIC SEPARATOR MANUFACTURER PARTNER

MAC MARKET OPPORTUNITY

MAC Product Market Segment	Sales (Ton/yr)	Total market ($/yr)
MINING (WORLD)	30,000	$75,990,000
MUNICIPAL (As - US)	135,000	$341,955,000
CHEMICAL (US)	23,000	$58,259,000
MEDICAL (US)	245,000	$620,585,000
POWER (US)	44,200	$111,958,600
MUNICIPAL (OTHER)	50,000	$126,650,000
INDUSTRIAL (US)	35,000	$88,655,000
GRND. WATER (US)	10,800	$27,356,400
TOTAL	573,000	**$1,451,409,000**

1) Chemical Profile CMR online - http://www.the-innovation-group.com/chemprofile.htm
2) http://www.the-innovation-group.com/ChemProfiles/Activated%20Carbon.htm
3) ESPI (2005) Estimations from: EPA (1997) EPA
4) EPA ECHO, National Research Council, PNCWA

DEVELOPMENT TIMELINE



CURRENT/PENDING FUNDING

Current Support Source (Contracts in place)	*(2005-2006)*	*Match*
NSF 0352482	$ 314,442	
NSF 0337258	$ 126,659	
Eriez Phase II SBIR	$ 116,685	
SUBTOTAL	**$ 557,685**	**~4:1**
Pending Support Source		
Proposals Submitted to Barrick	$ 570,000	
Proposal Submitted to Newmont	$ 50,000	
MSE Requested Proposal (DOE – EPA Validation)	$ 250,000	
New Mexico (State Drinking Water Evaluations)	$ 35,000	
SUBTOTAL	**$ 945,000**	
TOTAL	**$1,502,685**	**~10:1**

REQUESTED COE FUNDS

Category	(2005-2006)
Personnel	$130,000
Capital Equipment	$0
Marketing Subcontracts	$10,000
General Expenses	$10,000
Total	**$150,000**

COE funding will allow principal investigators and students to focus on development of product data and materials to effectively market MAC products